# Determination of Sex from Morphometry of Hyoid Bone

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**ABSTRACT**

*Assessment of human sex from skeletal remains plays a key role in anthropological and medico-legal studies. The present study was conducted to know the relationship of sex to size of hyoid bone. The study was done on 100 hyoid bones in different age groups obtained from medico-legal autopsies in Guntur Medical College, Guntur. All the studied parameters were greater in males than in females. The multi variant discriminate analysis of the studied 16 parameters is helpful to find out the sex of the person with much accuracy.*

**Key words**: *Hyoid bone, Cornu, Sex determination, Anthropometry*

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## INTRODUCTION

Identification of individual has greater significance in criminal investigations. Finding out age and sex from human skeletal remains is a routine procedure in the forensic medicine departments in India and plays a key role in solving the medico-legal disputes. Determination of sex from analysis of human skeletal remains has been an age old problem, especially if it is from an isolated bone. Even with human pelvis alone and skull alone sex can be determined with 95% and 92% accuracy[1] only. The metric analysis of the hyoid bone is a helpful technique in the sex determination of a skeleton.[2]

Hyoid bone is a 'U' shaped bone suspended from the tips of the stylohyoid ligaments[3]. It is a part of viscerocranium placed between the tongue root and thyroid cartilage to which it is connected by thyrohyoid membrane. It is placed at the level of the fourth cervical vertebra and articulates with surrounding structures via muscles (suprahyoid and infrahyoid muscle groups) and ligaments (stylohyoid ligaments). It presents a median unpaired body, a long large cornu on each side, and a small nodule, not always bony, the small cornu, situated above the junction of body and great cornu (Figure-1).[4]

## AIM

To establish a method of sex discrimination that could provide an accurate means of distinguishing between males and females and does so requiring the fewest osteometric measurements, helping the Forensic expert to come to a conclusion from the hyoid bone.

## MATERIALS AND METHODS

The present study was conducted in the Department of Anatomy, Guntur Medical College, Guntur, on100 hyoid bones collected from autopsied bodies as per the autopsy technique of Otto Saphir.[5] Out of 100 hyoid bones, 66 males and 34 females in age group of 15-75yrs were studied. The sample was divided into different age groups (Table 1). The damaged hyoid bones, mainly of hanging and strangulation cases, were excluded from the study.

Before starting the autopsy, age and sex of the cadaver was recorded.

## METHODS

The following anthropometric measurements were taken on each hyoid bone

1. Length of the greater cornu– right.
2. Length of the greater cornu– left.
3. Transverse distance between tubercles of greater cornua– External (outer measurement).
4. Transverse distance between tubercles of greater cornua- Middle (central measurement).
5. Transverse distance between tubercles of greater cornua- Internal (inner measurement).
6. Distance between internal surfaces of the greater cornua at their middle.
7. Length of the lesser cornu– right.
8. Length of the lesser cornu– left.
9. Minimum transverse distance between bases of lesser cornua.
10. Side to Side dimension (width) of the body in the middle.
11. Antero-posterior dimension of body in the middle.
12. Distance between the upper and lower margins of the body (height).

13. Vertical distance between middle of the anterior surface of the body and transverse line drawn between the tubercles of greater cornua in the midline.
14. Maximum depth of concavity on the posterior surface of the body in the middle.
15. Weight before defating.
16. Weight after defating.

All the parameters were recorded by Vernier Calipers, measuring scale (1-14 in mm) and electronic weighing machine (15th and 16th in grams).

## RESULTS AND DISCUSSION

By analyzing my study, all the above sixteen parameters of hyoid bone were more in males than females which are either highly significant (p <0.001) or significant (p< 0.001 and p<0.005). (Table 2)

The above parameters increase in their dimensions with age in males but in females there is a variation of size only in the lengths of greater and lesser cornua up to 25 years of age.

Till 1988, most of the research on hyoid bone was done by the western authors. In 1988 Ranjith C and Pillai S[6] and in 1996 Harjeet and Jit I[7] worked on the weight and morphometrics of hyoid bone respectively.

In the present study, it is observed that the male hyoid bone values are more (11.85 ± 1.53 mm) when compared to female (10.04 ± 1.01 mm) regarding the distance between the upper and lower margins of body in the middle (height). The P value is statistically significant in both sexes. The present study is correlating with other studies.[7,9&10] The male hyoids are larger than female hyoids in all parameters, the present study is similar with Harjeet and Jit I[7], the difference being statistically significant (P value < 0.001).

The previous authors studied on the transverse distance between tubercles of greater cornua – External[7,10] and the transverse distance between tubercles of greater cornua – Middle[7,8, 9 & 11] results were greater in males than in females. The present study result is the mean length of the greater cornu (right) in males which is 32.58 ± 2.34 mm and in females 28.43 ± 2.34 mm; the mean length of the greater cornu (left) in males is 32.37 ± 2.13 mm and in females is 28.42 ± 2.32 mm, shows that thisparameter in females is less than the males. This value is highly significant (p value < 0.001). The mean length of lesser cornu in males and females on right side is 6.04 ± 1.27mm and 4.81 ± 0.73mm whereas on left side it is 5.96 ± 1.36mm and 4.81 ± 0.62mm respectively. The result is more in males than in females and is highly significant (p< 0.001). The transverse distance between tubercles of greater cornua in males 46.32 ± 3.1mm was more that of females 38.01 ± 5.28mm. The observed value is highly significant (p < 0.001).The present study is correlating with Harjeet and Jit I[7] and Igor Leksan etal.[8]

According to Ranjith and Pillai S[6] the mean weight of the hyoid bone in male was 1.474 + 2.89.g and that of the female hyoid bone was 0. 960 + 2.33g. In the present study, the mean weight after defatting in male hyoids is 1.069 + 0.272g and in female hyoids it is 0.759 ± 0.152 grams, the present value is statistically significant (p value < 0.001). The present study is in accordance with previous reports (2) & (7). The mean weight after defatting is greater in males than in females.

**Table 1: Age Wise Sample Distribution**

| Age | Male | Female | Total |
|---|---|---|---|
| 0-10 | 0 | 0 | 0 |
| 11-20 | 4 | 5 | 9 |
| 21-30 | 6 | 6 | 12 |
| 31-40 | 8 | 10 | 18 |
| 41-50 | 25 | 11 | 36 |
| 51-60 | 17 | 2 | 19 |
| 61-70 | 6 | 0 | 6 |
| 71-80 | 0 | 0 | 0 |

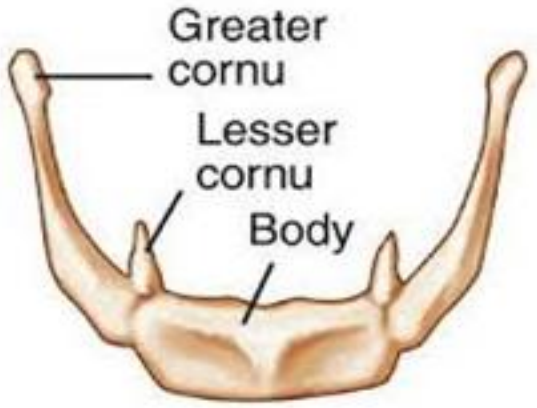


**Fig. 1**

**Figure 2: Measurement of length of greater cornu**

**Table 2: Statistical analysis of the studied parameters of hyoid bone in the adult males and females (15 - 75 years) 1-14 parameters in mm; 15 and 16 in gms.**

| S. no | Parameters | Males N-66 | | Females N-34 | | Level of significance |
|---|---|---|---|---|---|---|
| | | Mean ±SD | Range | Mean ± SD | Range | |
| 1 | Length of greater cornua right | 32.58±2.34 | 29 - 38 | 28.43±2.34 | 24-32.5 | P<0.05 |
| 2 | Length of greater cornua left | 32.37±2.128 | 29-38 | 28.42±2.32 | 24-32.5 | P<0.001 |
| 3 | Transverse distance between tubercle of greater cornua (external) | 46.32±8.31 | 37-70 | 38.01±5.28 | 30 – 47 | P<0.001 |
| 4 | Transverse distance between tubercles of greater cornua (Middle) | 42.74±8.24 | 28-66 | 35.00±5.80 | 25-44.5 | P<0.001 |
| 5 | Transverse distance between tubercles of greater cornua (Internal) | 39.03±8.17 | 23.5-62 | 32.27±6.0 | 21.5-41.5 | P<0.001 |
| 6 | Distance between internal surface of greater cornua at their middle | 33.29±4.66 | 21.5-43 | 28.02±2.80 | 24-32 | P<0.001 |
| 7 | Length of lesser cornua – right | 6.04±1.27 | 4.5-10 | 4.81±0.73 | 3.5-6 | P<0.001 |
| 8. | Length of lesser cornua - left | 5.96±1.36 | 4.5-10 | 4.81±0.62 | 4-6 | P<0.001 |
| 9. | Minimum transverse distance between bases of lesser cornua | 21.71±3.18 | 11.5-25 | 18.24±2.9 | 10.5-22 | P<0.001 |
| 10. | Width of the body in the middle | 23.24±3.07 | 13.5-28 | 20.0±1.47 | 18-23 | P<0.001 |
| 11. | Antero-posterior dimension of body in the middle | 6.14±1.90 | 4-9 | 5.60±0.97 | 4-8 | P<0.001 |
| 12. | Distance between the upper and lower margin of body in the middle (height) | 11.85±1.53 | 9-17 | 10.04±1.01 | 9-10.5 | P<0.001 |
| 13. | Vertical distance between middle of anterior surface of the body and transverse line drawn between tubercles of greater cornua in midline | 36.51±2.72 | 33-44 | 31.92±2.76 | 26-36 | P<0.001 |
| 14. | Maximum depth of concavity on the posterior surface of the body in the middle | 1.99±0.648 | 1-3 | 1.69±0.55 | 1-2.5 | P<0.01 |
| 15. | Weight before defating (gms) | 1.483±0.393 | 1.05-2.527 | 0.963±0.180 | 0.580-1.254 | P<0.001 |
| 16. | Weight after defating (gms) | 1.069±0.272 | 0.699-1.790 | 0.759±0.152 | 0.480-1.006 | P<0.001 |

**Table 3: Comparison of present study with Harjeet and Jit I study**

| Parameter | Male | | Female | | Level of Significance | |
|---|---|---|---|---|---|---|
| | Harjeet and Jit I | Present Author | Harjeet and Jit I | Present Author | Harjeet and Jit I | Present Author |
| 1 | 33.59±2.76 | 32.58±2.34 | 29.79±2.75 | 28.43±2.34 | P< 0.001 | P<0.005 |
| 2 | 33.90±2.84 | 32.37±2.12 | 29.66±2.38 | 28.42±2.32 | P<0.001 | P<0.001 |
| 3 | 44.59±6.31 | 46.32±8.31 | 38.65±4.85 | 38.01±5.28 | P<0.001 | P<0.001 |
| 4 | 41.65±6.32 | 42.74±8.24 | 35.56±5.03 | 35.0±5.80 | P<0.001 | P<0.001 |
| 5 | 37.24±5.85 | 39.03 ± 8.17 | 31.82 ± 4.76 | 32.27 ± 6.00 | P<0.001 | P<0.001 |
| 6 | 33.42 ± 3.38 | 33.29 ± 4.66 | 27.65 ± 3.08 | 28.02 ± 2.80 | P<0.001 | P<0.001 |
| 7 | 7.25 ± 2.05 | 6.04 ± 1.27 | 6.32 ± 1.53 | 4.81 ± 0.73 | P<0.001 | P<0.001 |
| 8. | 7.05 ± 1.70 | 5.96 ± 1.36 | 6.42 ± 1.50 | 4.81 ± 0.62 | P<0.001 | P<0.001 |
| 9. | 24.45 ± 2.35 | 21.71 ± 3.18 | 20.48 ± 2.42 | 18.24 ± 2.9 | P<0.001 | P<0.001 |
| 10. | 24.03 ± 2.36 | 23.24 ± 3.07 | 20.29 ± 1.55 | 20.0 ± 1.47 | P<0.001 | P<0.001 |
| 11. | 6.58 ± 1.88 | 6.14 ± 1.90 | 5.10 ± 0.95 | 5.60 ± 0.97 | P<0.001 | P<0.001 |
| 12. | 11.04 ± 1.10 | 11.85 ± 1.53 | 9.47 ± 1.08 | 10.04 ± 1.01 | P<0.001 | P<0.001 |
| 13. | 38.66 ± 3.29 | 36.51 ± 2.72 | 34.05 ± 2.82 | 31.92 ± 2.76 | P<0.001 | P<0.001 |
| 14. | 2.40 ± 0.70 | 1.99 ± 0.648 | 2.23 ± 0.67 | 1.69 ± 0.555 | P<0.001 | P<0.001 |
| 15. | 1.84 ± 0.36 | 1.483 ± 0.393 | 1.19 ± 0.30 | 0.963 ± 0.180 | P<0.001 | P<0.001 |
| 16. | 1.20 ± 0.31 | 1.069 ± 0.272 | 0.80 ± 0.23 | 0.759 ± 0.152 | P<0.001 | P<0.001 |

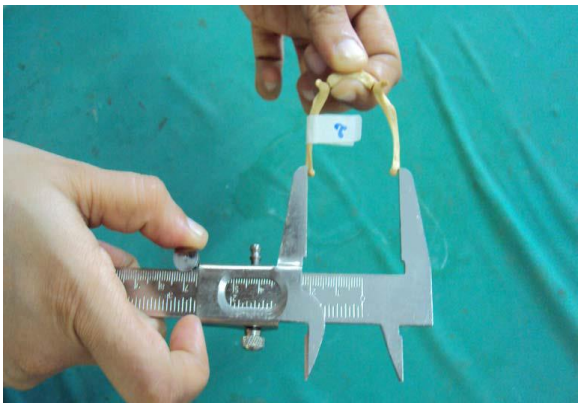

**Figure 3: Transverse distance between tubercles of greater cornua**

**Figure 4: Measurement of length of lesser cornu**

## CONCLUSION

All the readings of above parameters were greater in males than in females and some of them showed increase with advancement of age. In most of the parameters, there was a clear cut demarcation between the value of male and female bone. The present study indicates that the sex can be determined with maximum accuracy by taking the discriminant analysis of the different parameters of hyoid bone but the accuracy is not satisfactory if only one parameter is taken.

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## CONFLICT OF INTEREST

The authors have no conflict of interest, neither financial nor any other.

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